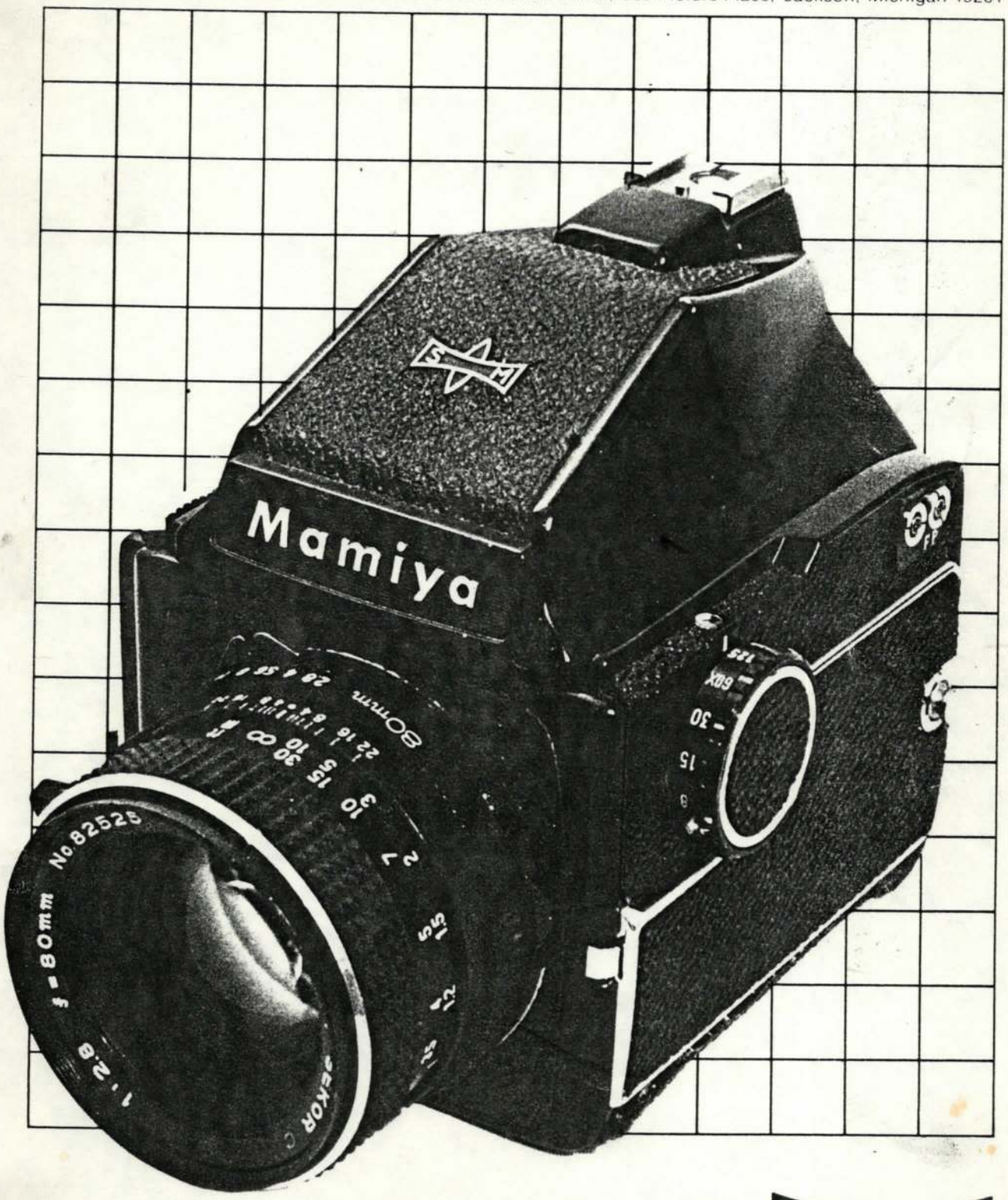
MAMIYA M645 *a Service Analysis for Members of*

NATIONAL ASSOCIATION OF PHOTO EQUIPMENT TECHNICIANS

A section of PHOTO MARKETING ASSOCIATION INTERNATIONAL, 300 Picture Place, Jackson, Michigan 49201



NAPET

CAMERA FEATURES

Exceptionally compact and quiet for a roll-film SLR, the M645 has become a favorite of wedding photographers and others who want a large negative from a relatively small camera. Follow-up models have only minor variations. The M645J, a less-expensive version, eliminates the top release button and the speeds slower than 1 second. And the top-of-the-line 1000S provides a top speed of 1/1000 (rather than 1/500) and a self-timer.

Here's a capsule of the camera:

Type: roll-film with 6mm x 4.5mm format; accepts different film inserts (Fig. 2), for 120 film (15 exposures) and for 220 film (30 exposures).

Shutter: vertically traveling, electronically controlled, cloth focal-plane shutter.

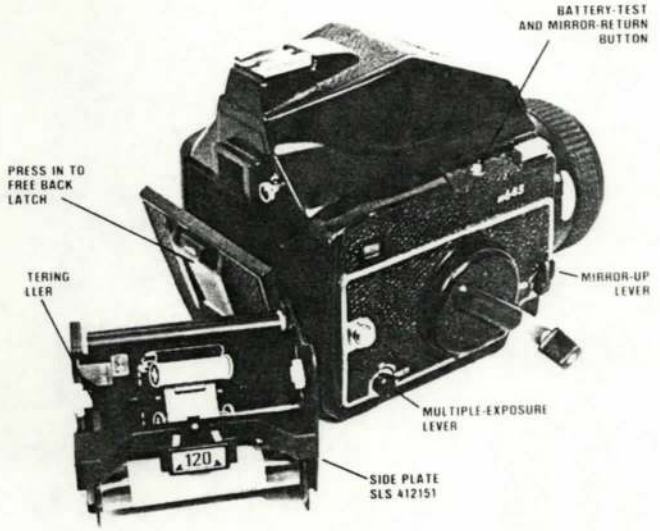


Figure 2
Film insert removed.

Curtain-travel time: 12 - 12.5ms (40mm sensor spacing).

Finder: interchangeable finders - prism, waist-level, CdS, AE (auto exposure), and PDM (photo diode).

Flange-focal distance: 62.95 ± 0.03mm to the inner (film-guide) rails, 63.30 ± 0.03mm to the outer (pressure-plate) rails.

Battery: one 6V PX28 or 544 at the bottom of the camera.

Current draw: approximately 3.7ma with the shutter open; the current draw briefly increases to around 6ma at the end of the exposure.

OPERATION AND CHECK-OUT

It takes very little in the way of special tools to service the M645. You can make most of the special tools in a few minutes. But there's one service problem - - measuring the curtain travel times (Fig. 3). Few test instruments will time the curtain speeds across a 40mm distance.

Consequently, you may have to set the curtain-travel times by applying the "normal" amount of initial tension to each take-up roller (Fig. 4), 4 turns on the first curtain and 2 turns on the second curtain. Then fine-tune the tension settings by eliminating the top-to-bottom variation at the fast speed.

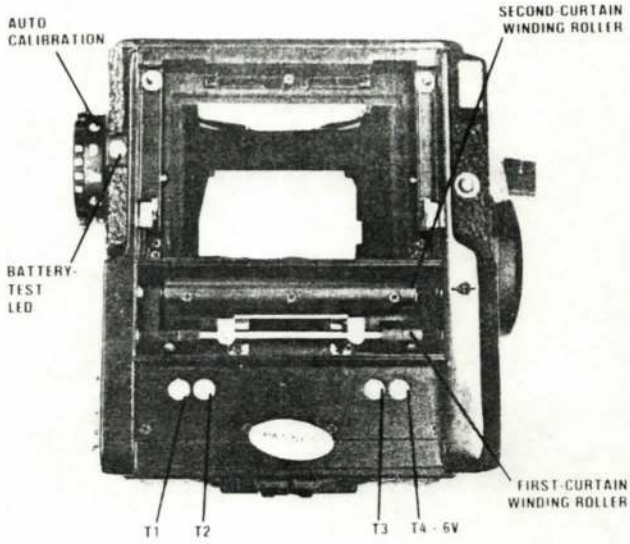


Figure 3
Top view, finder and cemented plate above curtain rollers removed.

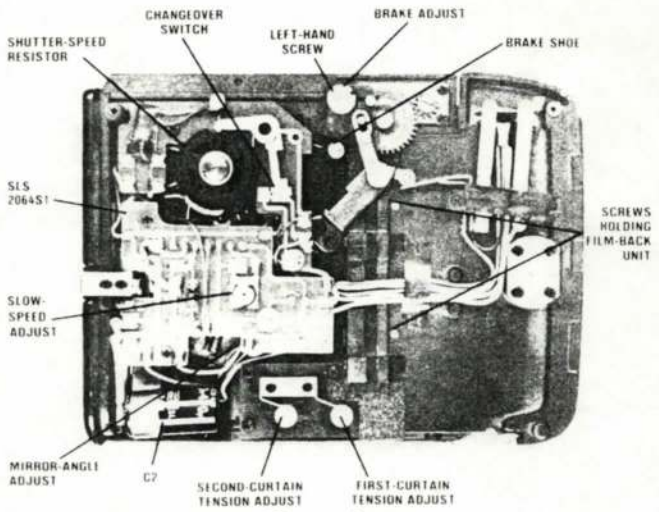


Figure 4
Speed-knob side of camera, changeover switch at bulb setting.

To check the shutter operation and speeds, first set the multiple-exposure lever (Fig. 2), to the multiple-exposure position. Now cock the shutter by rotating the wind knob one turn in a clockwise

direction. At the end of the wind stroke, you should feel a "click" as the wind ratchet disengages. You can then release the shutter.

et the multiple-exposure lever to the normal ition to check the metering action. Place a roll ..est film in the supply side of the roll-film insert; it's not necessary to load the film onto the take-up spool. As you rotate the wind knob, the test film turns the metering roller (Fig. 2), and the metering roller turns the counter dial.

An empty film spool, however, won't do the job - you need the added thickness of the film to reach the metering roller. The film insert shown in Fig. 2 has a demonstration spool in the supply chamber. A plastic sleeve on the demonstration spool engages the metering roller.

With the test roll installed, check to see that the counter dial advances to "15" before disengaging. The counter dial should not advance beyond "15" when you're using the 120 insert. With the 220 insert, the counter dial should not advance beyond the "30" calibration. The 220 insert disengages a counter-dial stop lever, thereby allowing the counter dial to complete its rotation.

CIRCUIT

The unique design of the M645 control circuit results in very low battery drain. With the shutter open, the M645 draws only around 3.7ma. By contrast, a 35mm camera using the 6V silver-oxide ery typically draws around 40ma with the tter open.

ut the M645 doesn't use the typical electromagnet to hold back the second curtain. Rather, the second-curtain latch mechanically holds the second curtain for the length of the exposure. Now the circuit draws current only to charge the timing capacitor C1 (on the back side of the circuit board (Fig. 4).

When the timing capacitor reaches the trigger voltage, the release capacitor C2 (Fig. 4), discharges through the coil of a solenoid (Fig. 5). The solenoid then repels its plunger, and the plunger kicks the second-curtain latch out of engagement with the second-curtain gear. At the end of the exposure, the current draw briefly increases to around 6ma as the circuit recharges C2 to 6V.

You can follow most of the operation with the wind-knob side of the camera removed (Fig. 5). When the mirror releases, the mirror-raising crank gear strikes a lever which closes the main switch. A catch lever then engages the main-switch lever, keeping the main switch closed for the full exposure.

Then, when the first curtain releases, the first-curtain latch opens the trigger switch (timing switch). Now the timing capacitor C1 starts charg- The charging time depends on the shutter- ed setting; selecting a slower speed simply ..nects a larger resistance value in series with C1.

The second curtain remains latched until C2 discharges through the coil of the solenoid. So, without a battery, the shutter hangs open. Most

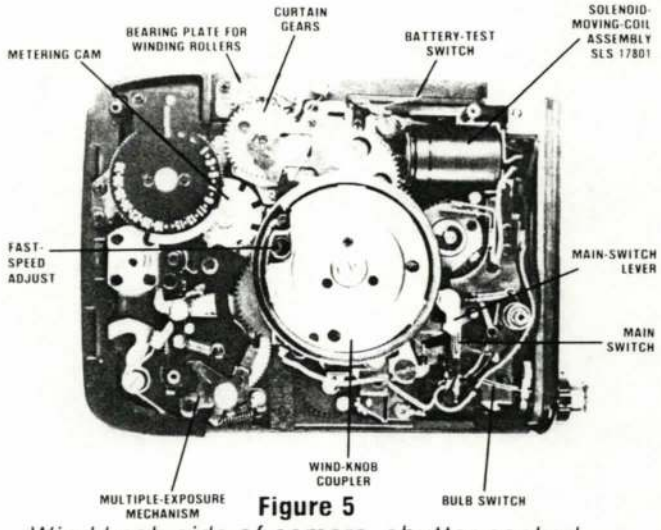


Figure 5

Wind-knob side of camera, shutter cocked.

electronic problems result in the same malfunction - - the shutter hangs open because the solenoid can't release the second curtain. You can close the shutter by pushing down the red battery-test button (Fig. 2). Besides closing the battery-test switch, the battery-test button comes against the lever which disengages the second-curtain latch.

You'll also find that the shutter hangs open at the automatic position of the speed knob (Fig. 3). Here, without the AE (automatic exposure) finder installed, the timing capacitor can't charge. It's up to the AE finder to provide the C1 charging path.

To check for proper operation without having the AE finder, set the speed knob to auto and release the shutter; the shutter should stay open. Then use your tweezers to short between terminals T1 and T2 (Fig. 3). The shutter should now close.

The other two camera-body terminals - - T3 and T4 - - couple battery power to the finder and provide the flash-sync signal to the finder's hot show. You should measure 6V between ground and terminal T4. Between terminal T3 and ground, an ohmmeter should show direct contact with the shutter held open.

DISASSEMBLY STEPS

Sequence to remove wind-side cover:

1. wind crank (depress tab, rotate counter-clockwise)
2. multiple-exposure and mirror-up levers (one screw each, under leatherette)
3. peel back two lower corners of lower leatherette section (at bottom of camera)
4. remove two screws, lower corners of cover plate
5. peel back two ends of upper leatherette section
6. remove two screws, upper corners of cover plate

7. unscrew retaining ring around strap post
8. remove wind-side cover (red battery-test button loose)

Note: the small cover screw goes next to the "M645" nameplate.

Sequence to remove speed-knob-side cover:

1. leatherette disc, center of speed knob
2. speed knob (two screws)

Note: in the 1000S, remove the speed-knob disc (two screws) and then the shutter-speed dial (three screws).

3. unscrew retaining ring around strap post
4. peel back corner of leatherette near FP terminal and remove screw
5. peel back top front corner of leatherette and remove screw
6. peel back ends of lower leatherette section (bottom of camera) and remove two screws
7. lift off cover plate

Sequence to remove front cover:

1. peel back four corners of leatherette and remove four screws
2. loosen three setscrews and remove release-button locking collar
3. remove front cover

Note: in the 1000S, you must also remove the self-timer lever. On reassembly, apply the initial tension to the self-timer-lever spring by turning the disc (front of self-timer lever) 90 degrees counterclockwise. Then tighten the screw holding the self-timer lever.

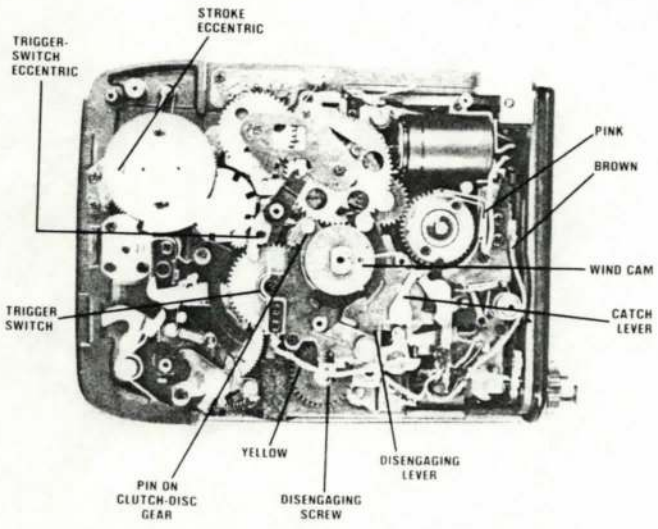


Figure 6

Wind-knob coupler and counter dial removed, shutter released.

Sequence to remove winding base unit:

1. remove wind-knob coupler (center screw and three screws accessible through cutouts)
2. lift off wind cam (Fig. 6)
3. remove the disengaging lever (Fig. 6), by disconnecting the spring and taking out the screw
4. remove the C-clip holding the clutch-disc gear (Fig. 6)
5. lift off clutch-disc gear
6. unsolder:
   - yellow wire from trigger switch
   - brown wire and pink wire from FP-sync contacts
7. lift aside main-switch assembly (two screws)
8. disconnect catch-lever spring (Fig. 6)

You can now take off the upper plate of the winding base unit by removing the five screws holding the plate (the small screw goes next to the trigger switch). Fig. 7 shows the upper plate removed. Alternately, you can remove the complete winding base unit as a module:

9. disconnect the mirror-return-lever spring (Fig. 7)
10. remove the screw holding the mirror-return lever with the spring
11. remove the mirror-return lever
12. remove the manual mirror-return lever (now loose, under the mirror-return lever)
13. disconnect release-slide spring (1000S only)
14. remove four screws holding winding base unit (at the corners of the assembly - - the short screw goes near the trigger switch)

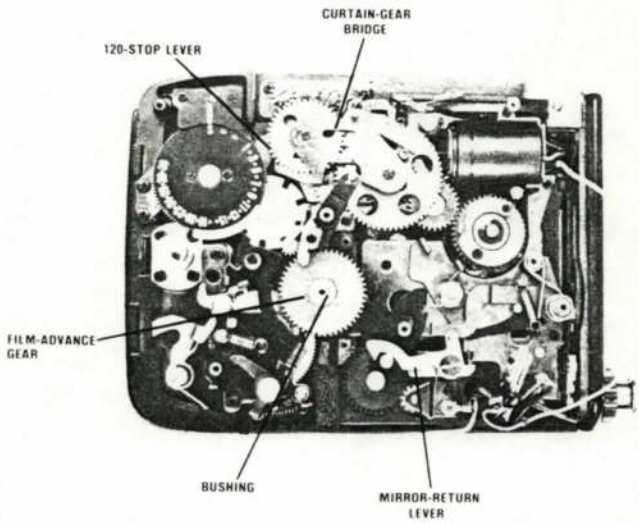


Figure 7

Top plate of winding base unit removed, shutter released.

Sequence to separate body unit from film-back unit:

1. remove both side covers
2. remove winding base unit
3. remove the bottom cover by taking out the four screws under the corners of leatherette
4. peel off porous-plastic light trap at bottom of camera
5. remove the cemented bottom plate over the curtain rollers

6. remove the four screws, two on each side of the camera. that hold the body unit to the film-back unit (the longer screws go on the speed-knob Fig. 6)
7. separate body unit from film-back unit (wires remain attached)
8. remove aperture plate

REASSEMBLY OF WINDING BASE UNIT

Here are the key points to note as you replace the winding base unit:

1. hold the release-slide link (Fig. 8), against the release button as you seat the winding base unit.
2. note the routing of the yellow wire to the trigger switch (Fig. 6), the routing is critical.
3. seat the clutch-disc gear as shown in Fig. 6. When you turn the clutch-disc gear counter-clockwise to take up the backlash, the brass pin should point to the screw as shown.
4. seat the wind cam with its punch mark pointing to the front of the camera (Fig. 6)

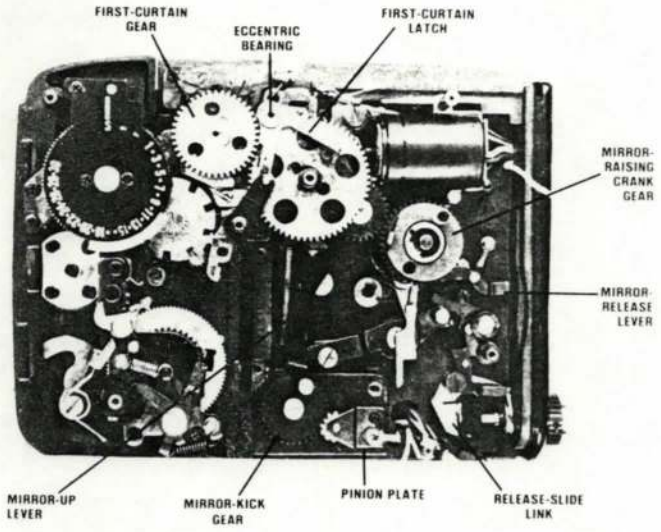


Figure 8

Winding base unit and curtain-gear bridge removed, shutter released.

ADJUSTING SHUTTER SPEEDS

The M645 has two primary shutter-speed adjustments - - the variable resistor on the circuit board (Fig. 4) and the eccentric on the trigger switch (Fig. 6). The variable resistor provides a level adjustment, and the trigger-switch eccentric provides a fast-speed adjustment.

However, except in the very early models, the first-curtain latch also has an eccentric (Fig. 8) for shutter-speed accuracy. The eccentric bearing for first-curtain latch allows you to precisely tch the mirror-up shutter speed with the shut- speed delivered in normal operation.

First compare the fastest shutter speed (1/500 in M645, 1/1000 in the 1000S) with the mirror locked up to the same shutter speed during normal operation. Use the eccentric bearing for the first-curtain latch to match the two exposure times.

Next adjust the 1-second exposure using the variable resistor (Fig. 4). Finally adjust the fastest speed by turning the trigger-switch eccentric after loosening the lock screw. For a faster speed, adjust the eccentric to make the trigger switch open sooner.

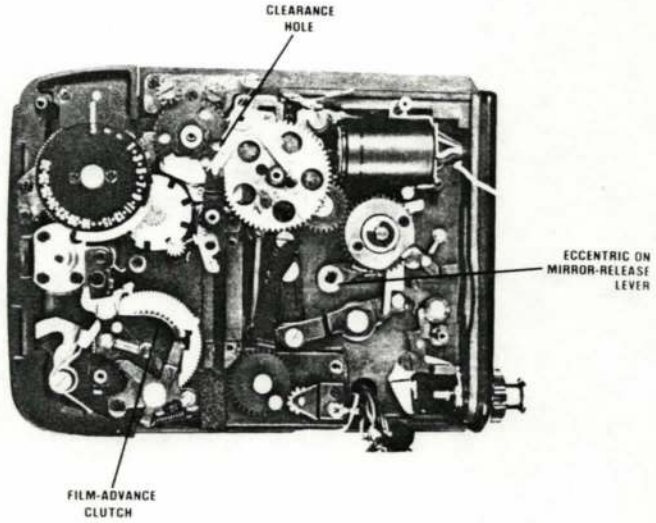


Figure 9

First-curtain gear removed, shutter cocked.

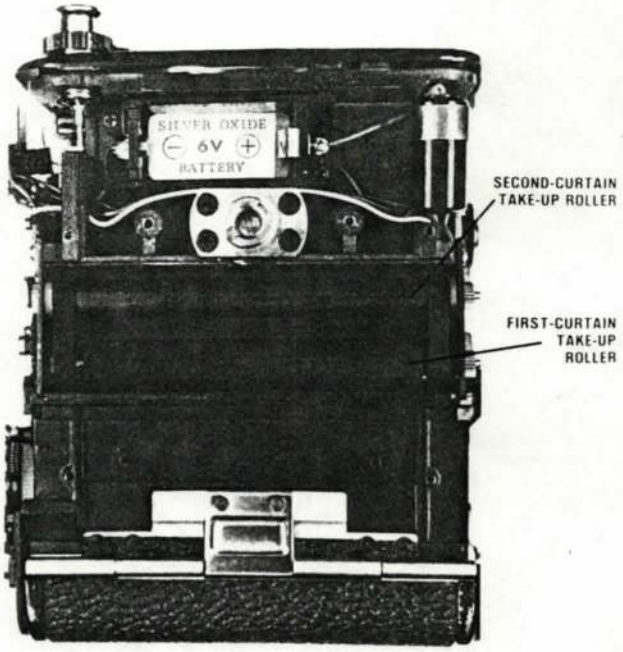


Figure 10

Bottom of camera, bottom cover and cemented plate over curtain rollers removed.

SHUTTER-TIMING PROCEDURES

1. Sequence

As you cock the shutter, you should first see the first-curtain latch drop into engagement. Next the second-curtain latch should engage. And finally you should feel the "click" as the wind ratchet disengages.

You can also check the sequence with the winding base unit removed. To cock the shutter, rotate the mirror-raising crank gear (Fig. 8) in a counterclockwise direction. Push down the mirror-release lever (Fig. 8) to release the mirror; the mirror should move up and release the first curtain. Release the second curtain by pushing down the manual-disengaging lever (the lever that the battery-test button comes against, Fig. 13). To return the mirror, push the mirror-up lever (Fig. 8) out of engagement with the mirror-lifting arm.

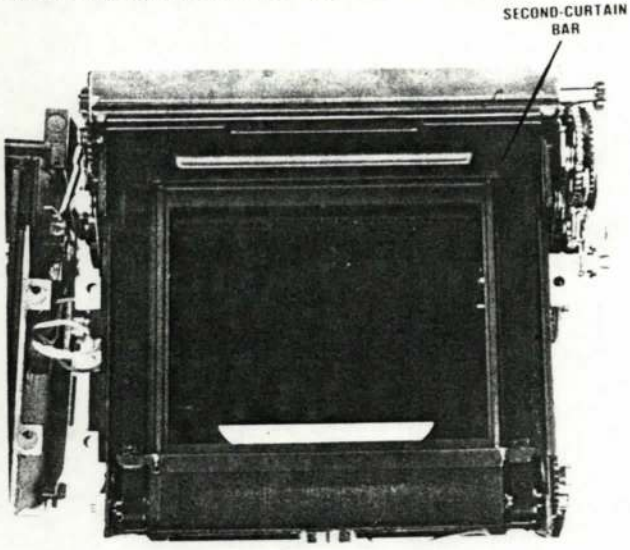


Figure 11
Back of body unit separated from film-back unit, second curtain held open.

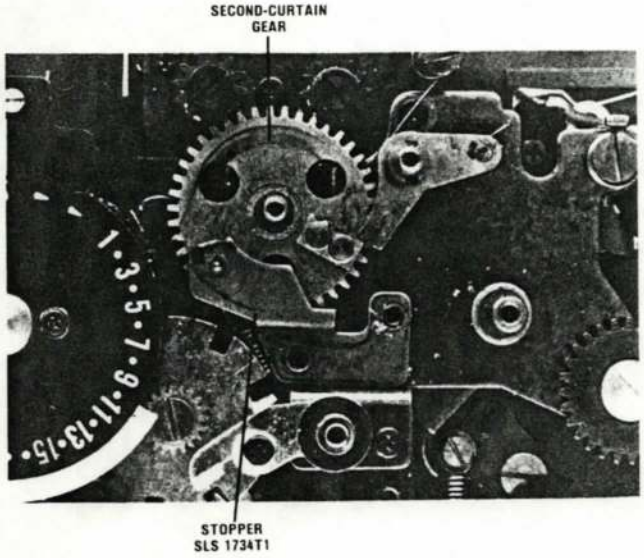


Figure 12
Second-curtain gear latched by second-curtain latch.

2. Timing the second-curtain gear

With the second-curtain gear latched by the second-curtain latch (Fig. 12) the lead edge of the curtain bar should be 3 to 4mm from the aperture. It's easy to note the curtain position if you've separated the body unit from the film-back

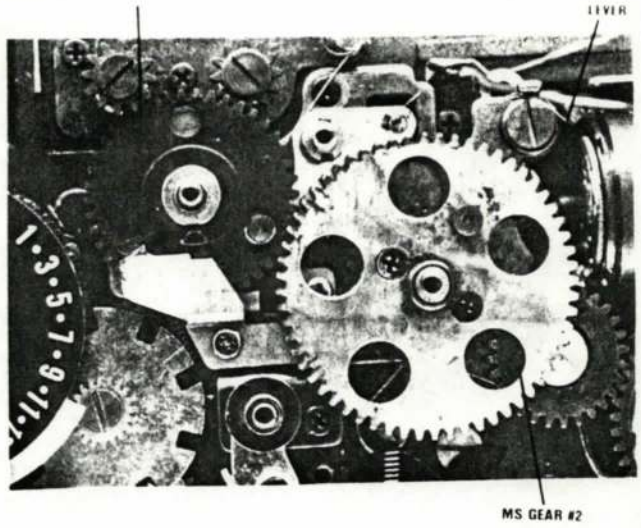


Figure 13
Timing positions for curtain-charging gears.

unit - - just change the timing between the second-curtain gear and the winding-roller pinion (Fig. 12) until the curtain bar aligns with the three dots at the top of the aperture (Fig. 11).

However, you can adjust the gear timing without separating the film-back unit. Since you can't then see the curtain bar, you might wish to make the gauge shown in Fig. 15. Mark two scribe lines on the gauge as shown - - one 3mm and one 4mm from the end. Then slip the gauge behind the aperture plate until the end of the gauge comes against the second-curtain bar.

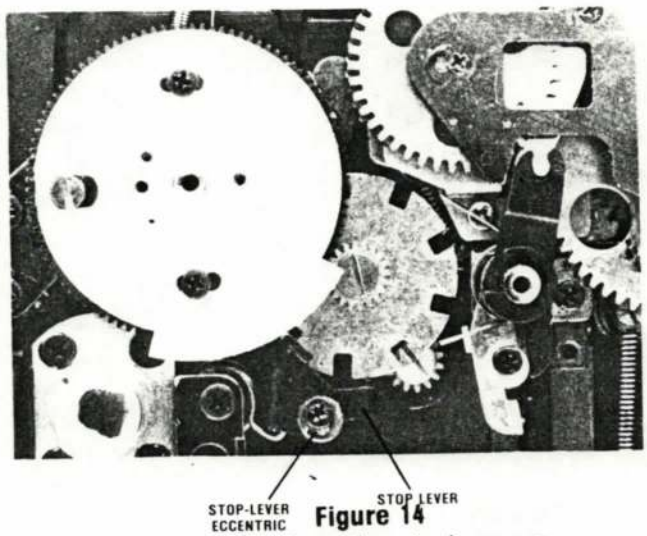


Figure 14
Timing position of metering cam.

3. Timing the first-curtain gear

Install the first-curtain gear as shown in Fig. 8. Then rotate the mirror-raising crank gear counterclockwise to advance the curtains about half way across the aperture.

Hold the second-curtain roller from the top (Fig. 3) and allow the mirror-raising crank gear to rotate

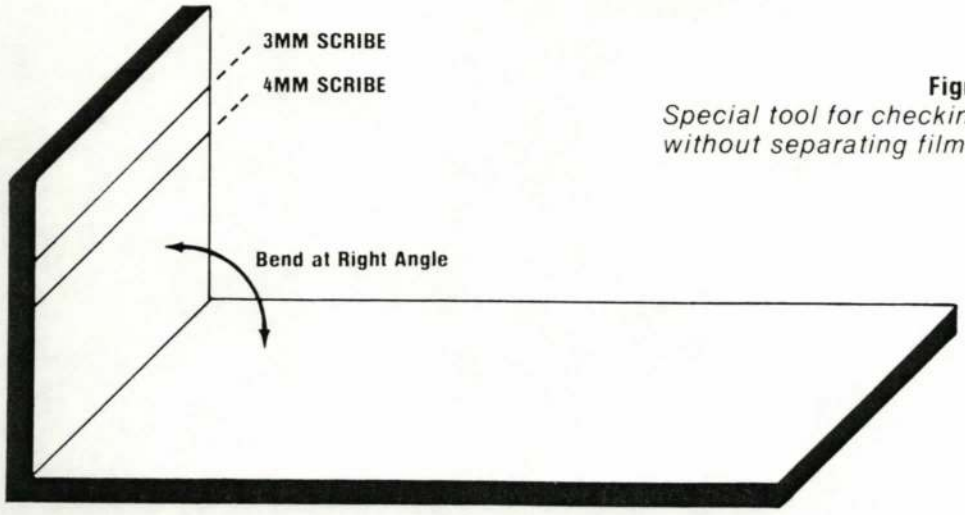


Figure 15
Special tool for checking second-curtain position without separating film-back unit from body unit.

clockwise. The first curtain now moves away from the second curtain, allowing you to judge the amount of overlap. Adjust the timing between the first-curtain gear and the winding-roller pinion for a one-bar overlap. To increase the overlap, rotate the first-curtain gear clockwise.

It's possible to adjust the overlap without removing the winding base unit. Loosen the three ...ws holding the curtain-gear bridge (Fig. 7). ... can then lift the first-curtain gear high ...gh to disengage it from the winding-roller pinion.

4. Timing the curtain-charge gears

Before installing MS gear #2 (Fig. 13) rotate the shutter-charging gear to position its lug as shown in Fig. 13. Then seat the MS gear with its pin at the 90-degree angle indicated.

5. Adjusting the overtravel of the second-curtain latch

Charge the shutter by turning the mirror-raising crank gear fully counterclockwise. Now look through the clearance hole (Fig. 9) to check the clearance between the latching lug on the second-curtain gear and the second-curtain latch. There should be a space gap of 0.3 to 0.6mm.

To adjust the space gap, re-time the shutter-charging gear. You can increase the space gap by turning the shutter-charging gear clockwise. Or, for a fine adjustment, use the eccentric pointed out in Fig. 9.

6. Adjusting the wind disengagement

At the end of the wind stroke, the disengaging lever (Fig. 6) pushes the advance pawl (part of the clutch-disc gear) out of engagement - - the disengaging of the advance pawl accounts for the ...k" you can feel at the end of the cocking ...e.

...e screw that the disengaging lever comes against (Fig. 6) allows you to adjust the "feel" at the end of the wind stroke. Turning in the screw provides a lighter feel; turning out the screw provides a harder feel. The proper feel is largely based on individual preference. However, if you turn out the screw too far, you won't be able to release the shutter.

TIMING PROCEDURES IN THE FILM-METERING MECHANISM

1. Sequence

With the 120 insert and a test roll installed, check to make sure the counter dial does not advance beyond "15." After exposure 15, the wind should turn freely.

The 220 insert should allow the counter dial to reach the "30" calibration. You can check the action without having the 220 insert. After the counter dial has reached "15," hold the 120-stop lever (Fig. 7) disengaged (away from the counter dial). You should then be able to continue cocking and releasing the shutter until the counter dial reaches "30." But the counter dial should not advance beyond the "30" position.

If the counter dial does not stop advancing at "15" and "30," check the film-metering adjustments which follow.

2. Timing the metering cam to the counter gear

Adjust the timing as shown in Fig. 14. When the counter dial is at the start position, the latching end of the stop lever should be within the indicated area - - between the center of the metering-cam tooth and the punch mark on the metering-cam tooth.

Early models don't have the punch marks on the metering cam. You can then adjust the timing so that the end of the stop lever centers on a metering-cam tooth. Double-check the timing by making sure the counter dial does not advance beyond the "15" and "30" calibrations.

3. Adjusting the stroke

The stroke adjustment determines when the metering action begins. To check, you can mark the test roll to show the proper start of the metering. Draw three lines on the inside of the paper backing - - one 230mm, one 218mm, and one

211mm - - from the start arrow. These lines note the allowable area at which the metering action should begin.

Now load the test film and advance the wind until the counter dial stops at "1." Hold open the shutter on bulb and check the test-film markings to see if the first frame is within the acceptable range - - 230 to 211mm from the start mark.

To adjust the stroke, remove the counter dial and loosen the two screws on the counter cam. Then turn the stroke eccentric (Fig. 6) to shift the counter-cam position.

4. Adjusting the stop-lever position

With the shutter released, there should be a 0.3mm space gap between the latching end of the stop lever and the edge of the metering cam (Fig. 14). The stop lever must positively engage the metering-cam slot at the end of the cocking cycle. Make the adjustment with the stop-lever eccentric (Fig. 14).

5. Aligning the counter dial

Loosen the two screws and rotate the counter dial to align the calibrations with the index. It's recommended that you adjust the counter alignment at the "23" position.

TROUBLESHOOTING

Most of what could be considered "common" malfunctions have been nearly eliminated by modifications. Occasionally, though, screws will work loose and cause other problems. For example, if the screws mounting the curtain rollers work loose, you may find curtain damage; the owner has damaged the curtains by forcing the wind mechanism.

You can replace curtains without separating the body unit from the film-back unit. Just remove the cemented plates, one at the top and one at the bottom of the curtain rollers. Fig. 3 and Fig. 10 show the cemented plates removed, providing access to the curtains.

In early models, another set of screws would more frequently work loose - - the screws holding the post for the mirror-raising crank gear. The symptom? The mirror sticks part way up. You can correct the problem by tightening and cementing the screws. However, Mamiya practically eliminated the malfunction in later models. The later models use four screws (rather than two screws) to hold the post.

Most malfunctions, though, seem to fall into one of two categories - - the shutter hangs open or the film spacing is incorrect. In each case, several different malfunctions can result in the same symptom. If the shutter hangs open, the problem usually lies in the electronic control circuit. An error in the film spacing normally indicates a mechanical problem in the film-metering mechanism.

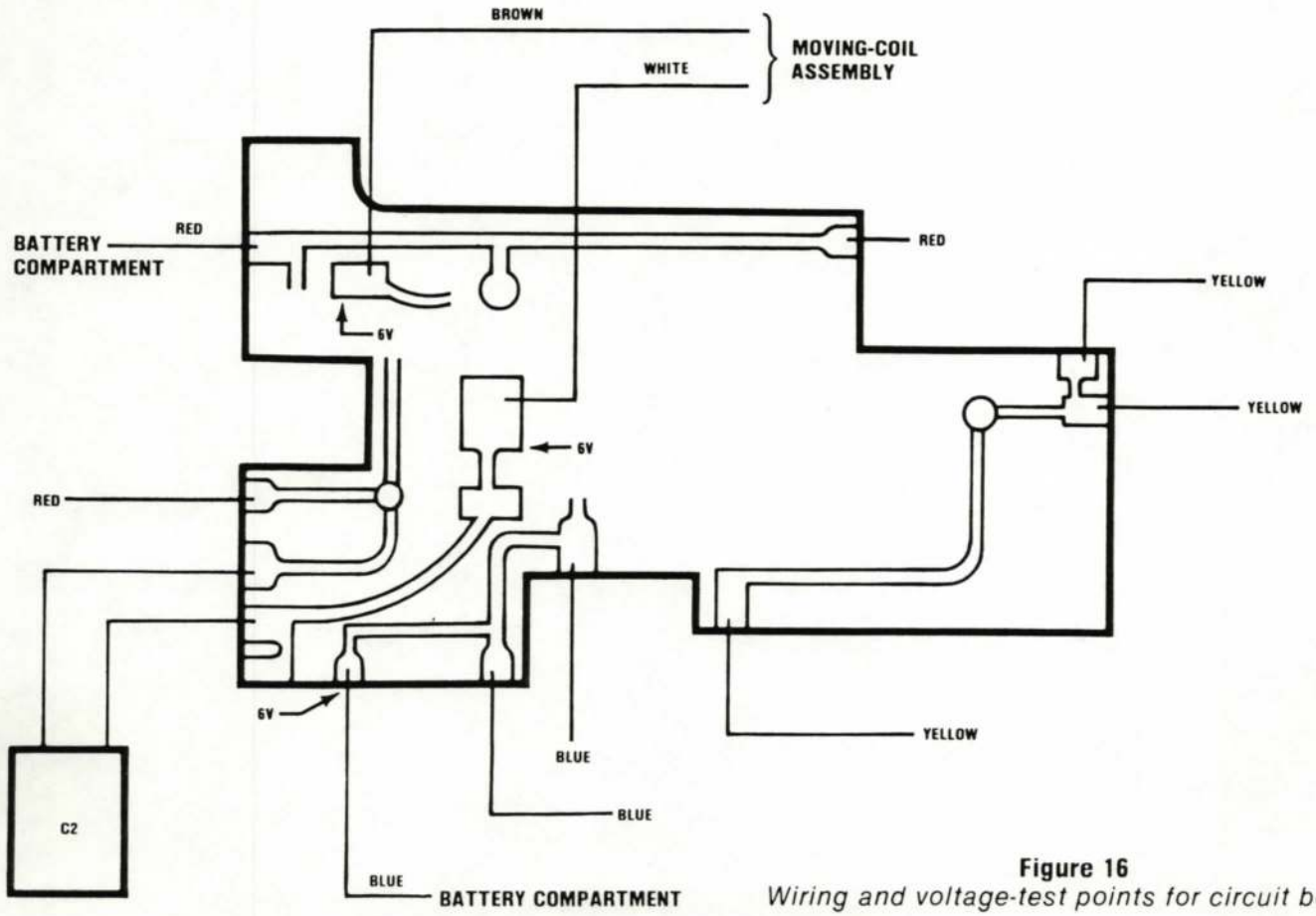


Figure 16
Wiring and voltage-test points for circuit board.

CHECKPOINTS WHEN THE SHUTTER HANGS OPEN

When the shutter hangs open, you know that, some reason, the solenoid has failed to kick second-curtain latch out of engagement. Try shing down the battery-test button to close the shutter. If the shutter does close, there's no mechanical problem. The malfunction must lie in the electronics.

You can make the voltage tests at the circuit board (Fig. 16). Note that you should measure 6V at the blue wire from the battery compartment. No voltage here indicates a problem with the battery terminals or the wiring. Also, you should measure 6V at capacitor C2 and at the release coil (solenoid) wires. If you measure 6V at one release-coil lead, but 0V at the other, the coil apparently has an open.

To check the coil continuity, you may wish to measure the resistance between the brown wire and the white wire (Fig. 16). The coil resistance should measure between 5 and 10 ohms.

However, there's an easier and faster way to check the coil. Set the shutter to bulb or to a fast speed. Then, with the shutter released, push closed the lower contacts of the main switch (Fig. 5). If the coil is good, it will repel its plunger. Alternately, short the coil housing to the lower blade of the battery-test switch (the tab with the blue wire, Fig. 5). Again, a good coil will repel the plunger. If not, replace the moving-coil assembly SLS 17801.

Poor contact in the main switch (Fig. 5) will also use the shutter to hang open. More likely, ...ough, you'll find that the main switch fails to close because of a simple mechanical problem - - the main-switch lever (Fig. 5) is sticking. If the main-switch lever doesn't move freely, clean both levers - - the lever which the gear strikes to close the main switch and the lever with the insulated post. Lightly lubricate the levers with shutter oil.

Also check the catch lever (Fig. 6) for freedom of movement. The catch lever must hold the main switch closed for the full exposure. Here are the other possibilities if the shutter hangs open:

1. loose ground screws on the circuit boards (Fig.4)
2. poor contact in the changeover switch (Fig. 4)
3. poor contact in the shutter-speed resistor (Fig. 4)
4. a defective capacitor C2 (Fig. 4) (replacement - condenser SLS 20661)
5. a defective timing capacitor C1 or circuit board SLS 2064S1

CHECKPOINTS FOR INCORRECT FILM SPACING

Improper film spacing may result from wear, improper gear engagement, or incorrect film-tering adjustments. Check first for wear in the l-film insert (Fig. 2). If the bearings in the side plate have worn, you'll feel "slop" in the metering roller and in the spool gear. Replace the complete side plate of the roll-film insert - - left panel SLS 4121S1.

In early models, there's another wear point to check - - the brass bushing pointed out in Fig. 7. Mamiya later changed to a bronze bushing to correct the wear problem. If you find a cracked or worn brass bushing, replace the complete plate SLS 1311S1. The new plate comes with the bronze bushing.

Insufficient engagement of the multiple-exposure mechanism (Fig. 6) may also result in film-spacing errors. To correct, just loosen the three screws holding the multiple-exposure mechanism. You can then shift the multiple-exposure mechanism closer to the film-advance gear.

Finally, check the film-metering adjustments described earlier:

1. the stroke adjustment
2. the stop-lever adjustment
3. the timing of the film-metering cam.

CURTAIN BOUNCE

The eccentric on the first-curtain brake (Fig. 4) allows you to adjust the amount of braking action. Rotate the eccentric after loosening the left-hand lock screw.

To check for first-curtain bounce, it helps to put a piece of white tape on the first-curtain bar. Then operate the camera while watching the curtains from the back of the aperture. The white tape makes it easier to see if the first curtain is bouncing.

You're more likely to encounter curtain bounce in the early versions of the camera. Originally, Mamiya used a round shoe on the braking lever. Then, to improve the braking action, Mamiya changed the shape of the shoe as shown in Fig. 4. If you run across the early style with the round shoe, you might replace the braking lever SLS 1861T2; you'll automatically get the modified version.

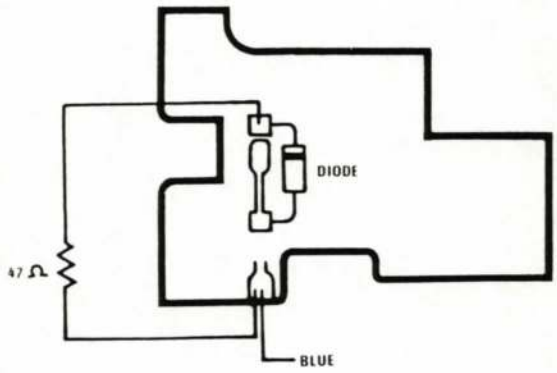


Figure 17

If the shutter hangs open when cocked quickly, but works properly when cocked slowly, add the resistor to the circuit board.

OTHER TROUBLESHOOTING STEPS

The following chart describes the checkpoints for other symptoms:

SYMPTOM	CHECK
Counter does not return when you remove the roll-film insert	1. Metering cam, binding Check to see if the metering cam turns freely. Also check to see if the metering cam is binding on the underside of the counter. If so, reform the metering cam.
Shutter does not close at bulb, other speeds o.k.	1. Bulb switch (Fig. 5) - - poor contact
Finder focus incorrect	1. Mirror-angle adjustment The mirror-angle-adjustment screw (Fig. 4) may have worked loose. Check the mirror angle before adjusting the focusing screen. To adjust the mirror angle, loosen the screw and slide the stop plate.
Noise at end of film wind	1. Film-advance clutch worn Check the ratchet gear inside the film-advance clutch (Fig. 9). Replacement - - ratchet gear SLS 14841.
Curtains cross aperture together	1. Second-curtain latch, insufficient overtravel
Click at beginning of wind stroke	1. Stopper for wind gears With the old-style stopper, the lug on the second-curtain gear could slip under the stopper after the exposure. The new-style stopper has a rivet to prevent the problem. Only the new style is supplied as a replacement (stopper SLS 1734T1).
Shutter closes, but mirror does not return	1. Timing of the mirror-kick gear Check the position of the pin on the mirror-kick gear (Fig. 8) with the shutter released. If the mirror-kick gear is out of time, the screws holding the pinion plate (Fig. 8) may have worked loose.
Hard wind stroke	1. Lubricate bearing for clutch-disc gear 2. Ratchet gear inside film-advance clutch binding 3. Excessive engagement between the curtain-winding gears and the roller pinions Check the depth of engagement between the curtain gears and the pinions on the winding rollers (Fig. 5). If the engagement appears excessive, loosen the two screws and shift the bearing plate for the winding rollers.
Battery drain	1. Main switch Check to see if the main-switch contacts are too close together. If so, shift the position of the main-switch assembly or reform the contacts.
Shutter hangs open if cocked quickly, but works properly if cocked slowly	1. Main-switch lever, sticking 2. Circuit If the main-switch lever is not the problem, add a 47-ohm resistor to the circuit board as shown in Fig. 17.

ACCESSORY FINDERS FOR THE M645

The accessory finders which provide internal metering work through the camera-body terminals through T4 (Fig. 3). Most of the electronic airs require replacing the complete circuit board (Fig. 18); individual circuit components aren't supplied as replacement parts. If the finder meter malfunctions, check for 6V at terminal T4 of the camera body. Also make sure the camera-body terminals are clean.

For automatic shutter-speed control, the AE finder uses a unique trap-needle system. The needle, when trapped in position, selects the actual resistance value in series with the timing capacitor. This resistance appears between terminals T1 and T2 (Fig. 3). The actual needle position then determines the charging time of the capacitor.

However, most professionals seem to prefer the PDM finder. The PDM finder provides semi-automatic metering, using LEDs to signal proper exposure settings. Although Mamiya provides excellent service manuals for the accessory finders, there's one drawback - - the service manuals describe using a special fixture to make the adjustments. The test points on the fixture refer to the test points shown in Fig. 18.

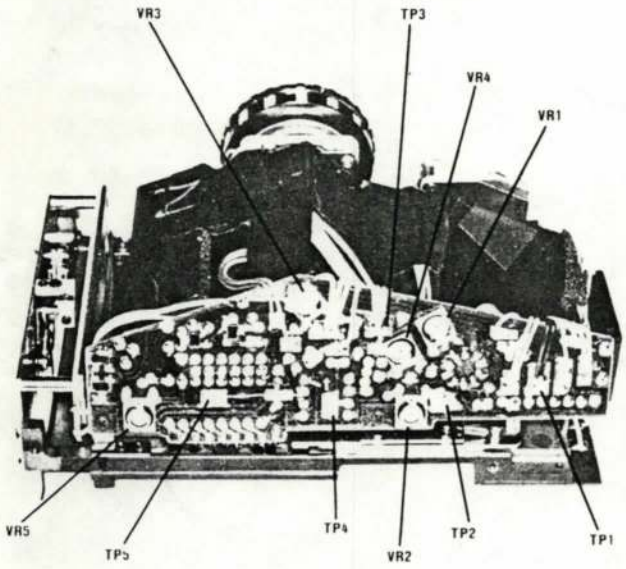


Figure 18
Test points and adjustments in PDM finder.

DISASSEMBLY SEQUENCE FOR THE PDM FINDER

1. leatherette at the center of the speed knob
2. leatherette at the center of the film-speed knob
3. set 1/500
4. speed knob (three screws)
5. ilm-speed knob (one screw)
   inder-locking knob (cover disc and center crew)
7. peel back leatherette sections on front nameplate
8. front nameplate (two screws)
9. top cover (four screws)

ADJUSTING THE PDM FINDER

To adjust the meter, you can use either the camera's battery or a separate DC power supply. Mount the finder, top cover removed, to the camera. Then, if you're using a DC power supply, remove the camera's battery. Connect the positive power-supply lead to the orange T2 lead wire at the back of the finder (accessible with the finder top cover removed). Connect the negative power-supply lead to the blue T4 lead wire.

Set the power supply to 5.99 - 6.01V. Now use a digital voltmeter to make the voltage measurements at the test points (TP1 - TP5) on the circuit board (Fig. 18). Shield the top of the finder from ambient light and, for the first four adjustments, cover the eyelens.

1. Measure the voltage between TP3 (+) and TP1. Adjust VR3 according to the type of PD finder -
   a. 1/1000 PD finder: - 0.233 to - 0.235V
   b. 1/500 PD finder: - 1.098 to - 1.102V
2. Set the light box to EV 11. With the camera's lens against the light source, measure the voltage between TP2 (+) and TP1. Adjust VR1 for a reading of - 0.360 to - 0.364V.
3. Check the voltage between TP4 (+) and TP1 at two light levels: EV 5 and EV II. Adjust VR2 so that the difference between the two readings is 0.107 to 0.109V. Since both readings change when you adjust VR2, repeat the procedure after each adjustment.
4. Set EV II, 1/30 second, ASA 100, f/8. Measure the voltage between TP5 (+) and the minus side of the power supply (or, if you're using the camera's battery, to the blue T4 lead wire or the blue battery wire at the camera circuit board. Adjust VR4 for a reading of 2.98 to 3.02V.
5. Check the LED read-out at the following combinations:
   a. EV 7, 1/2 second, ASA 100
   b. EV 11, 1/30 second, ASA 100
   c. EV 15, 1/500 second, ASA 100

At each combination, the green LED should light with the lens at f/8. The red under LED should light at 1/2 stop under f/8, and the over LED should light at 1/2 stop over f/8. Adjust with VR5.

CONCLUSIONS

Although we've emphasized troubleshooting in this report, the M645 has been a very reliable camera - - especially when you consider the abuse it often receives from hard-working professionals. Plus, among roll-film SLRs, the M645 has few peers when it comes to serviceability. You don't need an inventory of special tools or fixtures, and Mamiya supplies excellent service manuals.